

1043.01

# **Industrial Exposure and Control Technologies for OSHA Regulated Hazardous Substances**

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U.S. Department of Labor  
Elizabeth Dole, Secretary  
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Volume I of II  
Substances A-I

Occupational Safety and Health Administration  
John A. Pendergrass, Assistant Secretary

Cadmium dust and salts  
(CAS NUMBER: 7440-43-9)

#### SYNONYMS

Kadmium (German)

#### TRADE NAMES

NONE

#### DESCRIPTION OF SUBSTANCE

Elemental cadmium is a soft, blue-white malleable metal in Group IIB of the periodic table. The chloride, sulfate, nitrate, and most other salts are either soluble in water or dissolved by dilute acids and/or ammonia solutions. The sulfide, selenide, and telluride are colored (yellow, red, and black) and are practically insoluble in water. [ACGIH, 1986]

#### HEALTH EFFECTS

This substance is listed by the NTP as an anticipated human carcinogen, by IARC as a probable human carcinogen (groups 2a and 2b), by the ACGIH as a suspected human carcinogen (A2), and by NIOSH as an occupational carcinogen. Effects of overexposure: irritation of mucous membranes, dryness of mouth and throat, headache, nausea and dizziness. Inhalation may be harmful or fatal. Chronic effects of cadmium compounds from low level exposure in the air may include cancer, irreversible lung injury, kidney disease, and other adverse effects. Dust may irritate eyes. Causes renal dysfunction; affects respiratory tract. [ACGIH]

Cadmium is highly toxic. Ingestion of metal causes increased salivation, choking, vomiting, abdominal pain, anemia, renal dysfunction, diarrhea, tenesmus. Inhalation (dust or fumes): throat dryness, cough, headache, vomiting, chest pain, extreme restlessness and irritability, pneumonitis, possibly bronchopneumonia. [MERCK INDEX, 10TH ED 1983]

The most common abnormality found among cadmium-exposed workers is proteinuria. It was found in 81% of 43 workers exposed to cadmium for an average of 20 years in an alkaline storage battery plant; the protein involved was of low molecular weight. [PATY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82]

Inhalation: symptoms may not appear until 24 hours after exposure to cadmium has terminated, which may cause difficulties in obtaining the proper diagnosis. [FRIBERG. HDBK TOX OF METALS 1979]

"Itai-itai byo" disease, encountered in Japan mostly in women aged 45-70 years, was caused by cadmium intoxication. The disease is characterized by severe pain in the bones associated with osteomalacia, a waddling gait, amino aciduria, and glycosuria. [VENUGOPAL. METAL TOX IN MAMMALS 2 1978]

In a study of 347 men at 2 copper-cadmium alloy facilities in the U.K., an increased mortality noted for the group as a whole was largely due to an increased incidence of respiratory disease. No statistically significant increase in cancer, but an increase of reticuloendothelial tumors was observed. [HOLDEN H; PROCEEDINGS OF SECOND INTERNAT CADMIUM CONFERENCE CANNES P. 211-215 (1980)]

Peripheral lymphocytes from 24 workers at cadmium smelter showed an increased incidence of metaphase alterations as compared to controls. Some of the men had also been exposed to zinc and lead. [BAUCHINGER ME ET AL; MUTAT RES 40: 57 (1976)]

A previous retrospective mortality study of 292 U.S. cadmium production workers employed for a minimum of two years showed increased mortality from respiratory and prostate cancer and from non-malignant respiratory disease. To examine further the mortality experience of these workers the study was extended to include 602 white males with at least 6 months of production work in the same plant between 1940 and 1969. Vital status was determined through 1978, which included the addition of 5 years to the original follow-up. Cause-specific mortality rates for seven causes of death potentially related to cadmium exposure were compared between the overall cohort and U.S. white males and between subgroups. Mortality from respiratory cancer and from non-malignant gastrointestinal disease was significantly greater among the cadmium workers than would have been expected from U.S. rates. All deaths from lung cancer occurred among workers employed for 2 or more years. A statistically significant dose-response relationship was observed between lung cancer mortality and cumulative exposure to cadmium. A 50% increase in lung cancer mortality, which was not significant, was observed even among workers whose cumulative exposure to cadmium was between 41 and 200 ug/m<sup>3</sup> over 40 years. [THUN MJ ET AL; JNCI 74(2): 325-33 (1985)]

There is considerable evidence from human studies that renal tubular dysfunction occurs when cadmium levels in the kidney cortex exceed approximately 200 ug/g wet weight. [USEPA; HEALTH ASSESSMENT DOCUMENT: CADMIUM P. 1-11 (1981) EPA-600/8-81-023]

The chief chronic pulmonary effects of cadmium exposure are centrilobular emphysema and bronchitis resulting from several years of occupational exposure to cadmium oxide fumes, cadmium oxide dust, and cadmium pigment dust. [USEPA; HEALTH ASSESSMENT DOCUMENT: CADMIUM P. 1-11 (1981) EPA-600/8-81-023]

Studies have suggested that human exposure to cadmium (primarily as the oxide) is associated with increased risks of prostatic, respiratory, and genitourinary cancers, although in some cases the excess risk was not statistically significant. Three further studies have been reported. One is a follow-up of an investigation of 269 cadmium-nickel battery workers and 94 cadmium-copper alloy factory workers. Additional cases of nasopharyngeal, colorectal, prostatic and lung cancer increased the already elevated relative risks. [IARC MONOGRAPHS. 1972-PRESENT]

## TOXICITY/EXPOSURE LIMITS

NFPA RATING - NONE

TOXICITY HAZARD RATING - Acute and chronic local: skin 3; mucous membranes 3; eyes 3. Acute and chronic systemic: ingestion 3; inhalation 3; skin 3. 3= High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 610, 1984] 5. 5= Extremely toxic: probable oral lethal dose (human) 5-50 mg/kg, between 7 drops and 1 teaspoonful for a 70 kg person (150 lbs). [GROSSELIN. CTCF 5TH ED, P. II-134, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 40 mg/m<sup>3</sup> M /CADMIUM DUST [NIOSH; POCKET GUIDE TO CHEMICAL HAZARDS P.68, 1987]

OSHA PEL - \*\*\*\*\* ppm, 0.200 mg/m<sup>3</sup>;TWA  
\*\*\*\*\* ppm, 0.600 mg/m<sup>3</sup>;Ceiling  
Subject of 6(b) rulemaking.

ADOPTED ACGIH/TLV - \*\*\*\*\* ppm, 0.050 mg/m<sup>3</sup> as cadmium; TWA-A2  
- Suspected human carcinogen.

NIOSH/REL - Reduce exposure to lowest feasible limit -  
Potential human carcinogen

## INDUSTRY USE DATA

Cadmium and compounds are used in electroplating of automotive, aircraft and electronic parts; marine equipment and industrial machinery. [IARC MONOGRAPHS. 1972-PRESENT]

As soft solder and solder for aluminum; deoxidizer in nickel plating; process engraving; photometry of UV sun-rays; in electrodes for cadmium vapor lamps, photoelectric cells. [MERCH INDEX. 10TH ED 1983]

In fire protection systems, machinery enamels, baking enamels; Weston standard cell; photography and lithography; in manufacture of fungicides. [HAEM DICTNRY 9TH ED 1977]

Plating and coating agent- e.g., for transportation equipment. [SRI]

Component of batteries- e.g., nickel-cadmium batteries. [SRI]

Chemical intermediate for components of pigments-e.g., cadmium sulfide and chemical intermediate for plastic stabilizers-e.g., cadmium stearate. [SRI]

Component of alloys- e.g., for bearings and control rods. [SRI]

Analytical reagent- e.g., for determination of nitrate. [SRI]

Chemical intermediate for other cadmium compounds-e.g., cadmium

chloride. [SRI]

A constituent of easily fusible alloys, e.g., Lichtenberg's Abel's, Lipowitz', Newton's, and Wood's metal. [MERCK INDEX. 10TH ED 1983]

In low-melting and brazing alloys; in solar batteries; in television phosphors. [ITI. TOX & HAZARD INDUS CHEM SAFETY MANUAL 1982]

Neutron absorber in nuclear reactors; stabilizer for polyvinyl chloride; deoxidizer in nickel plating; amalgam in dentistry; in charging Jones reactors. [SITTIG M; HANDBOOK OF TOXIC AND HAZARDOUS CHEMICALS P.119 (1981)]

#### NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
3339	PRIMARY NONFERROUS METALS, NEC	160	67	41.87
3471	PLATING AND POLISHING	1,512	87	5.75

#### NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
2295	COATED FABRICS, NOT RUBBERIZE	1,244	185	14.87

#### OSHA/EXPOSURE DATA

NONE

#### ENGINEERING CONTROLS

Vent hood ventilation; use general or local exhaust ventilation; enclosure of process of worker.

#### PERSONAL PROTECTIVE EQUIPMENT

Eye, face, hand and arm protection and impermeable clothing. [ENCYC OCCUPAT HEALTH & SAFETY 1971]

Respiratory protection should be as follows: At any detectable concentration: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus and operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator with a high-efficiency particulate filter or any appropriate escape-type self-contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 69 (1987) DHEW

(NIOSH) PUB NO. 85-114}

**STORAGE**

Keep containers closed. Protect containers against physical damage. Storing, handling, and production should be performed under closed conditions, as much as possible. [ITII, P. 96, 1986]